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# APPEAL BRIEF FEE AUTHORIZATION

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# IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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|---|---|---|---|
| In re application of: | Gary F. Holland<br>Paul H. Wierenga | Docket: | 103003-200 |
| Serial No.: | 10/825,076 | Art Unit: | 3752 |
| Filed: | April 15, 2004 | Examiner: | NGUYEN, Dinh Q. |
| Assignee: | Aerojet-General Corporation | Conf. No. | 7149 |
| Title: | VEHICLE FIRE EXTINGUISHER | | |

## APPEAL BRIEF UNDER §41.37(c)

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

This is an appeal from the Final Rejection dated January 6, 2009, in which claims 41-53 and 55-65 of the above-identified application were rejected. A Notice of Appeal was filed on March 31, 2009 setting a due date of May 31, 2009 for the filing of this Appeal Brief.

05/18/2009 CCHAU1 00000052 231665 10825076

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**CERTIFICATE OF MAILING OR TRANSMISSION (37 CFR 1.8(a))**

I hereby certify that this correspondence (along with any paper referred to as being attached or enclosed) is being:

☒ deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to Mail Stop Appeal Brief-Patents, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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May 14, 2009 Signed: Gregory S. Rosenblatt

# APPEAL BRIEF FEE AUTHORIZATION

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## REAL PARTY IN INTEREST

The real party in interest in the above-identified patent application is Aerojet-General Corporation, the assignee of record, which is a division of GenCorp Inc.

## RELATED APPEALS AND INTERFERENCES

Claim 55 of the present patent application is drawn to the same patentable invention as claims 1-12, 17-25 and 28-29 of United States Patent No. 7,198,111 (the '111 Patent). The '111 Patent is titled "Automotive Vehicle with Fire Suppression System" by Dierker, Jr. et al. Claims 50 and 56 of the present patent application are drawn to the same patentable invention as claims 13-16 and 26-27 of the '111 Patent.

If Appellants' claims are deemed patentable, it is expected that an Interference will be declared between the present patent application and the '111 Patent. According to the face of the '111 Patent, the patent is assigned to Ford Global Technologies, LLC. According to the USPTO "Assignments on the Web" portal, the patent is assigned to Ford Motor Company.

A copy of the '111 Patent is appended to this Appeal Brief in the section titled "Related Proceedings Appendix."

## STATUS OF CLAIMS

Claims 1 – 40 are canceled.

Claims 41 – 53 are rejected.

Claim 54 is canceled.

Claims 55 – 65 are rejected.

Claims 66 – 70 are canceled.

The rejection of all rejected claims, that is claims 41 – 53 and claims 55 – 65 is appealed.

## STATUS OF AMENDMENTS

An Amendment after Final Rejection was submitted on February 18, 2009. By an Advisory Action mailed March 9, 2009, the Examiner indicated that the Amendment after Final Rejection was entered, however, the rejection of claims 41 – 53 and 55 – 65 was maintained.

# SUMMARY OF CLAIMED SUBJECT MATTER

## Claim 41

Claim 41 recites a method to suppress a vehicle fire (Page 3, line 14). A fire suppression system fit into an automobile (Page 11, lines 3-4 and Figure 1, reference numerals 100, 102) is activated after a rear impact collision is detected (Page 4, lines 27-32). The rear impact collision is detected by a sensor that detects acceleration, deceleration, speed, time, temperature, fuel, fuel level, fire, smoke, light transmittance or optical signature (Page 5, lines 16-18 and Figure 4, reference numerals 408 through 430). The fire suppression system has a container containing a propellant and a fluid fire suppressant (Page 11, lines 14-15 and Figure 1, reference numeral 104). When the system is activated, the propellant propels the fluid fire suppressant from the container (Page 6, lines 13-14). A surfactant in the fluid fire suppressant causes the expelled suppressant to form a film. This film forms at the fuel / air interface preventing ignition or reignition of the fuel (Page 10, lines 29-32).

## Claim 50

Claim 50 recites a method to suppress a vehicle fire (Page 3, line 14). A fire suppression system fit into an automobile (Page 11, lines 3-4 and Figure 1, reference numerals 100, 102) may be activated after a collision is detected by vehicle acceleration or deceleration (Page 17, lines 1-2 and Figure 4, reference numerals 408, 412). Activation is further dependent on the speed of the vehicle

(Page 17, lines 17 – 18 and Figure 4, reference numeral 412) and a delay time following the collision (Page 17, line 31 and Figure 4, reference numeral 404). The fire suppression system has a container containing a propellant and a fluid fire suppressant (Page 11, lines 14-15 and Figure 1, reference numeral 104). When the system is activated, the propellant propels the fluid fire suppressant from the container (Page 6, lines 13-14). A surfactant in the fluid fire suppressant causes the expelled suppressant to form a film. This film forms at the fuel / air interface preventing ignition or reignition of the fuel (Page 10, lines 29-32).

Claim 55

Claim 55 recites an automotive vehicle (Page 4, line 4 and Figure 1, reference numeral 100) with a fire suppression system mounted to the vehicle (Page 11, lines 3-4 and 13-15; Figure 1, reference numerals 100, 102). A distribution system conducts the fire suppressant from a storage tank to locations about the vehicle (Page 11, lines 15-17 and Figure 1, reference numerals 104, 106, 108). Sensors determine if the vehicle has been subject to an impact (Page 17, lines 1-2 and Figure 4, reference numerals 408, 410) and if the vehicle is moving after the impact (Page 17, line 7 and Figure 4, reference numeral 412). A control system connected to the sensor system and to the storage system causes the storage system to deliver fire suppressant to the distribution system when activated. (Page 16, lines 10-12 and Figure 4, reference numerals 402, 406 and 408-430).

Claim 56

Claim 56 recites a method to operate a fire suppression system that is installed on an automobile (Page 3, line 14 and Figure 4, reference numeral 406). If sensors detect both an impact (Page 4, lines 27-32 and Figure 4, reference numeral 408) and that the vehicle speed has crossed a predetermined threshold (Page 17, lines 8-18 and Figure 4, reference numeral 412), a fire suppressant is discharged from an onboard reservoir. (Fig. 1, reference numeral 104; Fig. 4, reference numerals 402 and 406).

The Evidence Appendix section of this Appeal Brief includes images from a video presented to the Examiner that illustrates features of the claimed subject matter. Following a rear impact collision (Top Left Image), fuel from a ruptured fuel tank spills on a roadway and ignites (Top Center Image). As the vehicle comes to a stop, leaking fuel pools under the vehicle and the fire follows a fuel trail under the vehicle (Top Right Image). After a delay, the fire suppression system is actuated (Bottom Left Image) extinguishing the fire (Bottom Center Image) with the vehicle substantially unscathed (Bottom Right Image). Note from these images that:

- The fire is about the vehicle and not contained within a compartment on the vehicle. A fire suppression system directed to compartments on the vehicle is ineffective.
- The vehicle leaks fuel for an extended period of time and metallic debris provides a stream of ignition sources. Actuating the fire

suppression system at impact may extinguish an initial fire, but when the suppressant is spent, additional fuel could ignite.

- The volume of flame is large, a fire suppressant that does not cover the flame volume is ineffective.

## GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Whether claim 41, 55 and 56 are unpatentable under 35 USC §102(b) as being anticipated by U.S. Patent No. 6,334,490 to Dille ("Dille").

Whether claims 42-49, 51-53 and 57 are unpatentable under 35 USC §103(a) as obvious in view of Dille. These claims depend from claim 41.

Whether claim 50 is unpatentable under 35 USC §103(a) as being obvious in view of Dille.

Whether claim 61 is unpatentable under 35 USC §102(b) as being anticipated by Dille. This claim depends from claim 55.

Whether claims 62 and 63 are unpatentable under 35 USC §103(a) as being obvious over Dille in view of U.S. Patent No. 5,992,529 to Parkinson et al. ("Parkinson"). These claims depend from claim 55.

Whether claims 64 and 65 are unpatentable under 35 USC §103(a) as being obvious in view of Dille. These claims depend from claim 55.

## ARGUMENT

I. Rejection under 35 U.S.C. 102(b) over Dille

An anticipation rejection under 35 U.S.C 102 requires that each and every element of the claimed invention be disclosed in a single prior art reference. *W.L. Gore & Assoc. v. Garlock, Inc.* 721 F.2d 1540 (Fed. Cir. 1983). The absence from the reference of any claimed element negates anticipation. *Atlas Powder Co. v. E.I. DuPont De Nemours,* 750 F.2d 1569 (Fed. Cir. 1984). These elements may be expressly disclosed or inherent. *Constant v. Advanced Micro-Devices Inc.*, 848 F.2d 1560 (Fed. Cir. 1988). If Appellants establish that a single element of the claims rejected under 35 U.S.C. 102(b) over Dille is missing from that reference, then the rejections under this section must be reversed.

Dille discloses a vehicle safety system having impact sensors (22) distributed around the perimeter of a vehicle. The impact sensors have pressure sensitive portions (48) (Dille at column 3, lines 13-14) that actuate the system when a predetermined degree of shock is detected (Dille at column 2, lines 45-47). Actuation causes the release of a foam gel that is injected into the passenger and cargo compartments to provide a protective and resilient coating (Dille at column 3, lines 1-3). Figure 1 of Dille illustrates all foam injector nozzles (26) are directed inwardly for directing the foam gel into these compartments.

As described in more detail in Appellants' traversal of the rejection of specific claims, Dille does not disclose adding a surfactant to a fire suppressant, directing the fire suppressant about the exterior of a vehicle and detecting any information other than a single isolated event (*e.g.* an impact).

A. Claim 41

Claim 41 includes a Markush Group of conditions responsive to which the fire suppression system is activated. The members of this group are acceleration, deceleration, speed, time, temperature, fuel, fuel level, fire, smoke, light transmittance and optical signature. The only condition disclosed in Dille to actuate a vehicle safety system is degree of shock (Dille at column 2, line 48).

Appellants' Markush Group is an artificial grouping of conditions to activate the fire suppression where no generic description exists to embrace that group and that group only. *Bristol-Meyers Squibb Co. v. Teva Pharmaceuticals USA, Inc.*, 288 F. Supp.2d 562 (S.D.N.Y., 2003). No member of the Markush Group is disclosed by Dille nor inherent in Dille. The Dille reference does not anticipate claim 41.

Claim 41 recites that the fluid fire suppressant includes a surfactant that enhances the film-forming capability of the suppressant. The film, as noted in

Appellants' specification at Page 5, lines 29-32, is to form a layer at the fuel/air interface of a fuel puddle fire to prevent ignition or reignition. There is nothing in Dille to anticipate or inherently suggest including a surfactant in the foam gel that forms Dille's resilient coating (Dille at column 3, line 3). Rather the Dille gel "solidifies upon exposure to air to protect the occupants and cargo." (Dille at column 2, lines 23-24).

There is nothing in Dille to anticipate or inherently suggest actuating a fire suppression system based on a condition included in the Markush Group of Appellants' claim 41. Further, there is nothing to anticipate or inherently suggest a film-enhancing surfactant in the resilient foam gels that Dille discloses. The rejection of Appellants' claim 41 in view of the Dille reference should be reversed.

B. Claim 55

Claim 55 recites that a fire suppressant agent is distributed ***about*** the vehicle body. ***About*** means locations around and near, not necessarily inside the vehicle, "locations at or near the ground surface" (Appellants'' specification at Page 11, line 16). Dille discloses injecting "the foam gel into the passenger and cargo compartment." (Dille at column 3, lines 1-2). Every injector nozzle (26) illustrated in Fig. 1 of Dille is directed inwardly to a compartment inside the

automobile. There is nothing in Dille to anticipate or inherently suggest distributing the fire suppressant about the vehicle.

Claim 55 further recites a sensor system that determines both if the vehicle has been subject to an impact and if the vehicle is moving subsequent to impact. While the sensor disclosed in Dille is effective to determine the first condition, whether the vehicle has been subject to an impact, nothing in Dille anticipates or suggests a sensor effective to determine if the vehicle is moving after impact.

There is nothing in Dille that discloses or inherently suggests a sensor that detects motion following an impact. The inwardly directed injector nozzles (26) and the Dille specification at column 2, line 24, "to protect occupants and cargo," disclose that both the Dille safety system and the beneficiaries of the safety system are located inside the vehicle. The Dille fire suppression system and the beneficiaries of the system are both inside the vehicle and inextricably linked together. There is no motion of one from the frame of reference of the other. Whether the vehicle is moving or not is irrelevant to the Dille system. A motion detecting sensor is not anticipated by, inherent from, or suggested by the Dille patent.

Dille neither anticipates nor suggests distributing a fire suppressant about a vehicle body, nor includes a sensor effective to actuate a fire suppression system

based on whether the vehicle is moving. The rejection of claim 55 over the Dille reference should be reversed.

Appellants respectfully traverse the Examiner's support for this rejection found in the Advisory Action mailed March 9, 2009:

> "The Examiner relying on the Dille reference for the teaching of the claimed automobile conditions, wherein the automobile condition of the Dille reference is when the automobile is decelerated to a stand still speed of due to the collision."

Appellants are not able to identify any disclosure in Dille related to the speed, or lack of speed, of the automobile. Rather as an object of Dille (at column 2, lines 22-24) is to provide a perimeter of a protective coating gel which solidifies upon exposure to air to protect the occupants and cargo, Appellants believe that Dille intends to discharge the gel as quickly as possible so the foam may protect the occupants and cargo from post-impact, but pre-stopping, injury, such as if the vehicle rolls over due to the crash. Once the vehicle is stopped, the resilient foam is likely superfluous.

C. Claim 56

Claim 56 includes the process steps of sensing the vehicle's speed following impact and discharging a fire suppression agent when the vehicle speed crosses a

predetermined threshold. Appellants' sensor determines a condition of the vehicle, vehicle speed, relative to an external frame of reference, the ground. The only sensor disclosed in Dille is an impact sensor (Dille at column 3, line 11) that measures a degree of shock (Dille at column 2, line 48). The Dille sensor is oblivious to an external frame of reference. The Dille sensor could not distinguish between a 15 mph impact on a stationary vehicle and a 65 mph rear impact on a vehicle moving 50 mph (65 mph – 50 mph = apparent 15 mph impact).

Dille neither anticipates, inherently discloses, nor suggests a sensor capable of determining vehicle speed and a system that actuates a fire suppression agent at a predetermined speed. The rejection of Appellants' claim 56 in view of Dille should be reversed.

D. Claim 61

Claim 61 depends from and further limits and defines claim 55, adding the further limitation that a gas generator generates a propellant that delivers the fire suppressant agent. Appellants' specification at Page 6, lines 13-23 discloses that with a gas generator, the high pressure gas used to propel the fluid fire suppressant is generated by the gas generator discharge and results in an "elimination of a high-pressure nitrogen pressurant" (lines 22-23).

Dille discloses a pressurized gas propellant containing tank (32) at column 2, lines 58-59. There is nothing in Dille to anticipate, inherently disclose, or suggest any system to generate a propellant that does not require a tank of pressurized gas. The rejection of Appellants' claim 61 in view of Dille should be reversed.

Claim 61 depends from claim 55. In addition to the propellant source distinction, claim 61 should be patentable over Dille for same reasons as claim 55. Claim 55 is considered patentable because Dille does not disclose a distribution system for dispersing fire suppressant about the vehicle body and does not disclose a sensor effective to determine if the vehicle is moving subsequent to a crash.

II. Rejections under 35 U.S.C. 103(a) in view of Dille

An evaluation of 35 U.S.C. 103 obviousness rejections includes an analysis of the objective features as delineated in *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1 (1966) and the further refinement of what constitutes obviousness as set out in *KSR International Co. v. Teleflex Inc. et al.*, 550 U.S. 398 (2007).

The *Graham* factors are (1) determine the scope and content of the prior art, (2) determine the differences between the prior art and the claims at issue, and (3) establish the ordinary skill in the pertinent art.

(1) Determine the Scope and Content of the Prior Art

As recited on Page 8 of Appellants' Amendment dated October 29, 2008, which summarizes Appellants' interview with the Examiner, conventional fire fighting wisdom is to attack the fire as quickly as possible. This conventional wisdom is found in the references applied against the claims in the § 103 rejections, Dille and Dille in combination with Parkinson. A similar understanding is disclosed in two references mentioned, but not applied, in the Final Rejection: Rhines (U.S. Patent No. 5,613,564) and Italiane et al. (U.S. Patent No. 6,612,243).

Dille (column 3, lines 17 – 20):

> Thus, any portion of the vehicle 14 protected by the safety system 10 will ***immediately*** protect the occupants and cargo when an impact or collision is detected by the impact sensors 22. (emphasis added)

Parkinson (column 1, lines 29 - 32):

> One area of particular concern is the occurrence of fires in motor vehicles where the danger posed by ruptured fuel lines or the like can result in extremely dangerous situations if the fire or source of flame is not ***rapidly extinguished.*** (emphasis added)

Rhines (column 2, lines 38 – 40), the vehicle fire extinguisher:

> (4) is automatically activated upon the occurrence of a collision, ***before a fire breaks out.*** (emphasis added)

Italiane et al. (column 10, lines 57 – 58):

> ***Quick (150 ms)*** and uniform deployment of the fire suppression agent. (emphasis added)

(2) Determine the Differences Between the Prior art and Claims at Issue

The specific differences between the prior art and a particular claim rejected under 35 U.S.C. 103 are discussed in detail below. The differences include the presence or absence of a surfactant; whether activation is immediate or delayed following detection of an impact; the condition detected by a sensor; and the frame of reference of the sensor *vis a vis* the vehicle and the ground.

(3) Level of Ordinary Skill in the Pertinent Art

The prior art discloses mechanical fire suppression systems suggesting that one skilled the art has the technical ability to develop a fire extinguisher system and install that system in a vehicle. That person having ordinary skill in the art has been taught by the prior art (see disclosures of Dille, Parkinson, Rhines and Italiane et al. as discussed above) that to extinguish a vehicle fire, a suppressant should be deployed as quickly as possible.

*KSR International* adds to the *Graham* factors that an obviousness analysis should be flexible and expansive and that a combination that unites old elements with no change in their respective functions is not patentable. What matters is the objective reach of the claim. If the claim extends to what is obvious, it is invalid under § 103. The Court indicates that a teaching away remains a strong indication of nonobviousness. In light of *KSR*, two questions drawn to obviousness are:

1. Whether an engineer beginning with Dille would have found it obvious to (a) add a surfactant to the fire suppression composition and (b) delay activation of the fire suppression system following detection of an impact.

2. Whether the prior art teaches away from (a) adding a surfactant to the fire suppression composition and (b) delaying activation of the fire suppression system following detection of an impact.

The Appellants establish below that the answer to Question 1 is "no" and the answer to Question 2 is "yes". Therefore, the claims should be found not obvious and the rejection of the claims reversed.

A. Claims 42-46 and 51-53

With respect to claims 42-46 and 51-53, the Examiner concluded that Dille teaches all limitations of the claims except for activating the fire suppression

system on a predetermined condition and added that at the time the invention was made, "it would have been an obvious matter of design choice to a person of ordinary skill in the art to provide the device of Dille with the activating the fire suppression system on a predetermined condition." (Final Rejection mailed 01/06/2009 at page 3).

Appellants first traverse the Examiner's preliminary statement that "Dille teaches all limitations of the claims except ..." . These claims depend from claim 41 and that claim includes a surfactant in the fluid fire suppressant to enhance film-forming capability. Dille discloses "a protective and resilient foam gel" (column 3, line 3) to "protect occupants and cargo" (column 3, line 19). An additive to the foam that enhances film-forming capability would likely make the foam too thin to be effective for protecting occupants and cargo. If the proposed modification, in this instance, addition of a surfactant, would render the prior art being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900 (Fed. Cir. 1984).

Regarding the specific sensor recited in the dependent claims that the Examiner concluded is an "obvious matter of design choice," this conclusion is traversed because the sensor is capable of detecting acceleration or deceleration of the vehicle. An impact sensor, as disclosed in Dille, detects the force of an impact

independent of whether the vehicle is moving or stationary. A stationary vehicle struck with sufficient force would activate the Dille safety system. The injector nozzles 26 illustrated in Dille are all directed inwards toward compartment in the vehicle. As such, whether or not the vehicle is moving, at what speed, and whether accelerating or decelerating are all irrelevant in the Dille system. There is no design incentive which would have prompted one skilled in the art to modify the Dille system to add an acceleration / deceleration sensor. The standard as set forth in *KSR* is whether a designer of ordinary skill, facing a wide range of needs created by developments in the field of endeavor, would have seen the benefit of updating the prior art with the claimed design modification. As motion is invisible to the Dille system, Appellants respectfully suggest that the benefit was not apparent and the rejection of claims 42-46 and 51-53 should be reversed.

B. Claims 47-49 and 57

With respect to claims 47-49 and 57, the Examiner concluded that Dille teaches all limitations of the claims except for activating the fire suppression system on a predetermined condition and added that at the time the invention was made, "it would have been an obvious matter of design choice to a person of

ordinary skill in the art to provide the device of Dille with the activating the fire suppression system on a predetermined condition."

Appellants traverse the Examiner's preliminary statement that "Dille teaches all limitations of the claims except ..." . These claims depend from claim 41 and that claim includes a surfactant in the fluid fire suppressant to enhance film-forming capability. Dille discloses "a protective and resilient foam gel" (column 3, line 3) to "protect occupants and cargo" (column 3, line 19). An additive to the foam that enhances film-forming capability would likely make the foam too thin to be effective for protecting occupants and cargo. If the proposed modification, in this instance, addition of a surfactant, would render the prior art being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon* (supra).

Appellants respectfully request that the rejection of claims 47-49 and 57 should be reversed

C. Claim 50

> Knowing when the vehicle is stopped or coming to a stop after a collision is important since activation of the fire suppression system at such time takes place where it is most likely that fuel has been spilled or will accumulate underneath the vehicle. (Appellants' Specification at Page 17, lines 9-11)

Proceeding contrary to accepted wisdom in the art is evidence of nonobviousness. *In re Hedges,* 783 F.2d 1038 (Fed. Cir. 1986). Claim 50 recites that activation of the fire suppression system occurs after "*a time delay after acceleration or deceleration condition indicative of a collision*". Not only does Dille teach away from the inclusion of a surfactant in the fluid fire suppressant as recited in claim 50, but claim 50 proceeds contrary to conventional wisdom by delaying actuation of the fire suppression system.

Appellants' traversal of the Examiner's preliminary statement that "Dille teaches all limitations of the claims except ..." as applied to claim 41 applies equally to claim 50. Claim 50 also recites a surfactant in the fluid fire suppressant to enhance film-forming capability. Dille discloses "a protective and resilient foam gel" (column 3, line 3) to "protect occupants and cargo" (column 3, line 19). An additive to the foam that enhances film-forming capability would likely make the foam too thin to be effective for protecting occupants and cargo. If the proposed modification, in this instance, addition of a surfactant, would render the prior art being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon,* (supra).

It is respectfully solicited that neither Dille nor any other reference of record in the present application, either alone or in combination, teaches or suggests the invention claimed in claim 50 and the rejection of this claim should be reversed.

D. Claim 60

With respect to claim 60, the Examiner concluded that Dille teaches all limitations of the claims except for placing the discharged fire suppressant at an underside of the vehicle and added that at the time the invention was made, "it would have been an obvious matter of design choice to ... place the discharging of the fire suppressant where it is most effective to fight fires".

Appellants first traverse the Examiner's preliminary statement that "Dille teaches all limitations of the claims except ..." . These claims depend from claim 41 and that claim includes a surfactant in the fluid fire suppressant to enhance film-forming capability. Dille discloses "a protective and resilient foam gel" (column 3, line 3) to "protect occupants and cargo" (column 3, line 19). An additive to the foam that enhances film-forming capability would likely make the foam too thin to be effective for protecting occupants and cargo. If the proposed modification, in this instance, addition of a surfactant, would render the prior art being modified

unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, (supra).

Regarding discharge to the underside location of a vehicle, Dille discloses a protective coating gel that solidifies upon exposure to air to protect the occupants and cargo (Dille at column 2, lines 23-24). Directing the gel forming composition away from passengers and cargo would render this prior art unsuited for its intended purpose so, in accord with *In re Gordon (supra)*, there is no suggestion or motivation to make the change suggested by the Examiner.

The rejection of Appellants' claim 60 should be reversed.

E. Claims 64 and 65

With respect to claims 64 and 65 that recite discharging the fire suppressant about an underside of the vehicle, the Examiner determined that Dille teaches all limitations of the claims except for activating the fire suppression system on a predetermined condition and added that at the time the invention was made, it was "well within one skilled in the art to place the discharging of the fire suppressant where it is most effective to fight fires" Appellants first traverse the Examiner's preliminary finding in that both claims depend from claim 55 that recites a sensor

determines whether the vehicle is moving subsequent to an impact, which is neither taught nor suggested by Dille.

Regarding the specific discharge location, the Examiner's "obvious matter of design choice" conclusion is traversed because Dille discloses a protective coating gel that solidifies upon exposure to air to protect the occupants and cargo (Dille at column 2, lines 23-24). Directing the gel forming composition away from passengers and cargo would render this prior art unsuited for its intended purpose so, in accord with *In re Gordon (supra)*, there is no suggestion or motivation to make the change suggested by the Examiner.

The rejection of Appellants' claims 64 and 65 should be reversed.

III. Rejection under 35 U.S.C. 103(a) over Dille in view of Parkinson

A. Claims 62 and 63

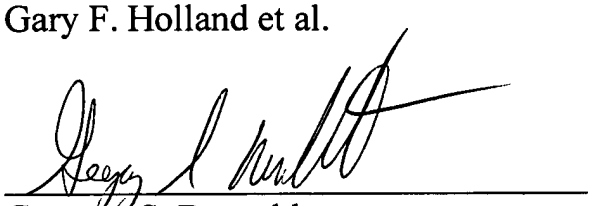
Parkinson discloses a solid propellant fire extinguisher useful to extinguish motor vehicle fires (at column 1, line 29) and that the fire should be rapidly extinguished (column 1, line 32). Claims 62 and 63 depend from and further limit claim 55. Dille does not discloses a distribution system for dispersing fire suppressant about the vehicle body and does not disclose a sensor effective to determine if the vehicle is moving subsequent to a crash. Parkinson does not teach

or suggest these features and the rejection of claim 62 and 63 in view of the combination of references should be reversed.

## CONCLUSION

Appellants respectfully request that the Board of Appeals reverse the outstanding rejections under 35 U.S.C. §§ 102 and 103 of instant claims 41-53 and 55-65 on appeal. Any fees due with this Appeal Brief may be charged to Deposit Account **23-1665**.

Respectfully submitted,
Gary F. Holland et al.



Date: May 14, 2009

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# CLAIMS APPENDIX

List of the claims involved in the Appeal.

41. A method for suppressing vehicle fires, comprising:

sensing a rear impact collision; and

activating a fire suppression system fit into an automobile according to at least one condition selected from the group consisting of acceleration, deceleration, speed, time, temperature, fuel, fuel level, fire, smoke, light transmittance and optical signature in response to said rear impact collision, and wherein the fire suppression system includes a container containing a propellant and a fluid fire suppressant, wherein the propellant is functional to propel the fluid fire suppressant from the container; and a surfactant in the fluid fire suppressant enhances the film-forming capability of the fluid fire suppressant on a fuel.

42. The method of claim 41, further comprising: activating the fire suppression system after expiration of a time period on a condition of acceleration or deceleration that is indicative of a collision.

43. The method of claim 41, further comprising: activating the fire suppression system on a condition of acceleration or deceleration that is indicative of a collision and on a condition of temperature that is indicative of a fire.

44. The method of claim 41, further comprising: activating the fire suppression system on a condition of acceleration or deceleration that is indicative of a collision and on a condition of smoke that is indicative of a fire.

45. The method of claim 41, further comprising: activating the fire suppression system on a condition of acceleration or deceleration that is indicative of a collision and on a condition of speed that is indicative of the vehicle slowing down.

46. The method of claim 41, further comprising: activating the fire suppression system on a condition of acceleration or deceleration that is indicative of a collision and on a condition of speed that is indicative of the vehicle stopping.

47. The method of claim 41, further comprising: aborting the fire suppression system so as not to activate even if one or more instruments are indicating a condition that would otherwise cause activation.

48. The method of claim 41, further comprising: activating the fire suppression system with a manual activate switch even if the instruments are indicating a condition that would otherwise not cause activation.

49. The method of claim 41, further comprising: activating the fire suppression system on any two conditions selected from the group consisting of acceleration, deceleration, temperature, speed, smoke, fuel level, fuel, time and fire.

50. A method for suppressing vehicle fires, comprising: activating a fire suppression system fit into an automobile on a condition of acceleration or deceleration and on a condition of speed and on a condition of time, provided the vehicle has reached a minimum speed condition and a time delay after an acceleration or deceleration condition indicative of a collision is adjusted according to the speed that is in excess of the minimum speed at the time of collision, and wherein the fire suppression system includes a container containing a propellant and a fluid fire suppressant, wherein the propellant is functional to propel the fluid fire suppressant from the container; and a surfactant in the fluid fire suppressant enhances the film-forming capability of the fluid fire suppressant on a fuel.

51. The method of claim 41, further comprising: activating the fire suppression system on a condition of acceleration or deceleration indicative of a collision and on a condition of fuel being detected that is indicative of a fuel spill.

52. The method of claim 41, further comprising: activating the fire suppression system on a condition of acceleration or deceleration indicative of a collision and on a condition of fuel level that is indicative of a fuel spill.

53. The method of claim 41, further comprising: activating the fire suppression system on a condition of acceleration or deceleration indicative of a collision and on a condition of fire being detected.

55. An automotive vehicle, comprising:

a vehicle body;

a reservoir containing a fire suppressant agent, with said reservoir being mounted in proximity to said body;

a distribution system for receiving the fire suppressant agent from said reservoir and for conducting the fire suppressant agent to at least one location about said body;

a sensor system for determining whether the vehicle has been subjected to an impact and whether the vehicle is moving subsequent to such an impact; and

a controller, operatively connected with said sensor system and said reservoir, for causing said reservoir to initiate delivery of the fire suppressant agent from the reservoir to the distribution system.

56. A method for operating a fire suppression system installed in an automotive vehicle, comprising the steps of:

sensing an impact upon the vehicle;

sensing the vehicle's speed following the impact; and

discharging a fire suppression agent from an onboard reservoir in the event that the vehicle's speed crosses a predetermined speed threshold following sensing of an impact.

57. The method of claim 41 including selecting said propellant to be a solid propellant.

58. The method of claim 57, further comprising: activating the fire suppression system on a condition of acceleration or deceleration detecting a collision and provided that the vehicle has reached a desired speed following said collision.

59. The method of claim 57, further comprising: activating the fire suppression system on a condition of acceleration or deceleration detecting a collision and after a predetermined period of time following said collision.

60. The method of claim 57, wherein said fire suppressant is discharged at an underside location of said vehicle.

61. The automotive vehicle of claim 55 wherein said reservoir includes a gas generator effective to generate a propellant for establishing a pressure effective to deliver said fire suppressant agent to said distribution system.

62. The automotive vehicle of claim 61 wherein said gas generator is a pyrotechnic gas generator.

63. The automotive vehicle of claim 62 wherein said propellant is selected to be a solid.

64. The automotive vehicle of claim 61 wherein said at least one location about said body includes an underside of said vehicle body.

65. The automotive vehicle of claim 62 wherein said at least one location about said body includes an underside of said vehicle body.

# EVIDENCE APPENDIX

The images that follow are from a video presented to the Examiner during a personal interview on October 15, 2008 and referenced in the Interview Summary.

**Top Row / Left** – A rear impact collision at a speed of 75 miles per hour.

**Top / Center** – Vehicle moves forward spilling fuel. Fuel from ruptured gas tank ignites.

**Top / Right** – Vehicle comes to a stop. Burning fuel ignites fuel pool under vehicle.

**Bottom / Left** – Following a delay after impact, fire suppression system deploys about the exterior of vehicle.

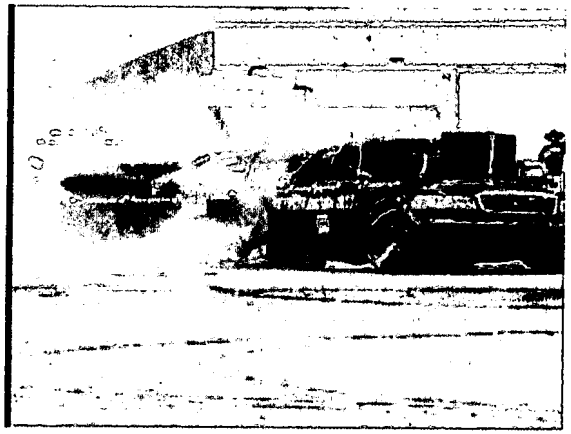
**Bottom / Center** – Fire suppression system depleted.

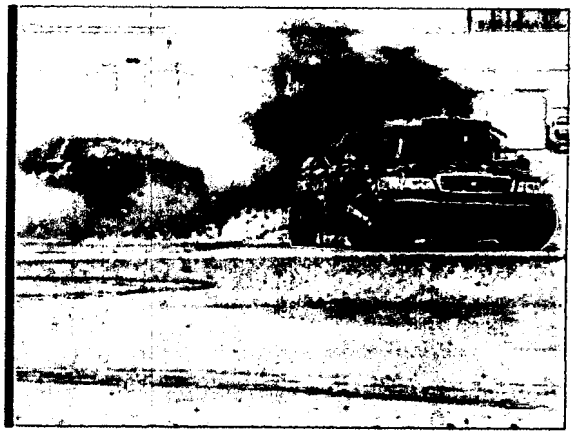
**Bottom / Right** – Fire extinguished, vehicle relatively unscathed by flames.

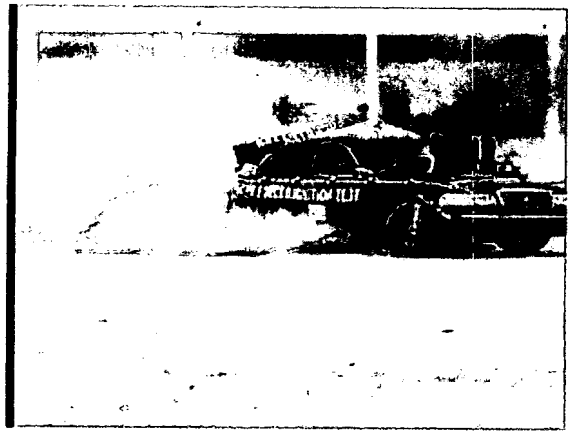
AEROJET

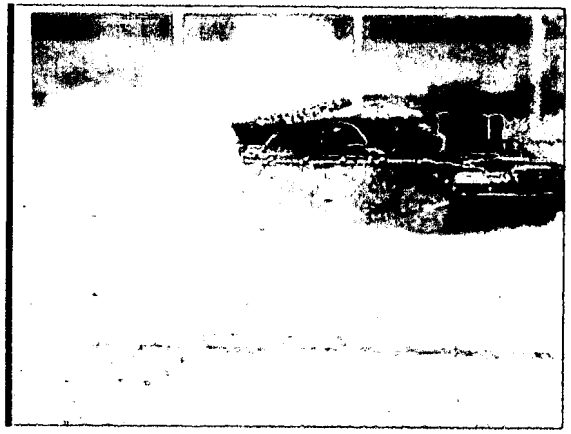
# Crash / Fire Test Success

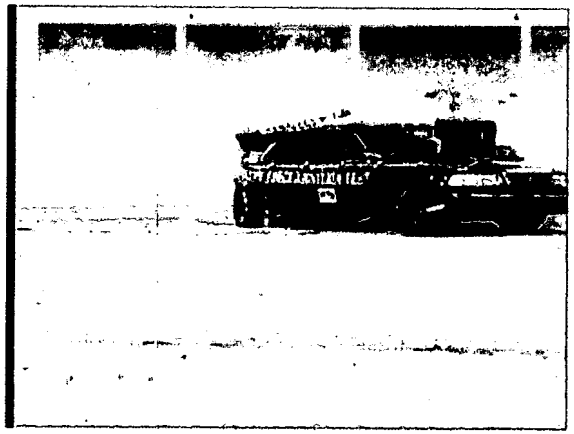
*75 mph impact*











***Aerojet Fire Suppression Systems defeat the toughest fires***

# RELATED PROCEEDINGS APPENDIX

Allowance of the claims in the present patent application is expected to provoke an interference with United States Patent No. 7,198,111. Appended is a copy of the '111 Patent.

US007198111B2

(12) **United States Patent**
**Dierker, Jr. et al.**

(10) **Patent No.: US 7,198,111 B2**
(45) **Date of Patent: Apr. 3, 2007**

(54) **AUTOMOTIVE VEHICLE WITH FIRE SUPPRESSION SYSTEM**

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(73) Assignee: **Ford Global Technologies, LLC**, Dearborn, MI (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(22) Filed: **Mar. 22, 2005**

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(51) **Int. Cl.**

| | |
|---|---|
| ***A62C 3/07*** | (2006.01) |
| ***A62C 35/00*** | (2006.01) |
| ***A62C 37/10*** | (2006.01) |
| ***A62C 37/00*** | (2006.01) |
| ***A62C 3/00*** | (2006.01) |
| ***A62C 35/58*** | (2006.01) |

(52) **U.S. Cl.** ..... **169/62**; 169/61; 169/60; 169/56; 169/85; 169/46

(58) **Field of Classification Search** ..... 169/62, 169/61, 60, 56, 85, 46, 54, 84, 9, 16, 71
See application file for complete search history.

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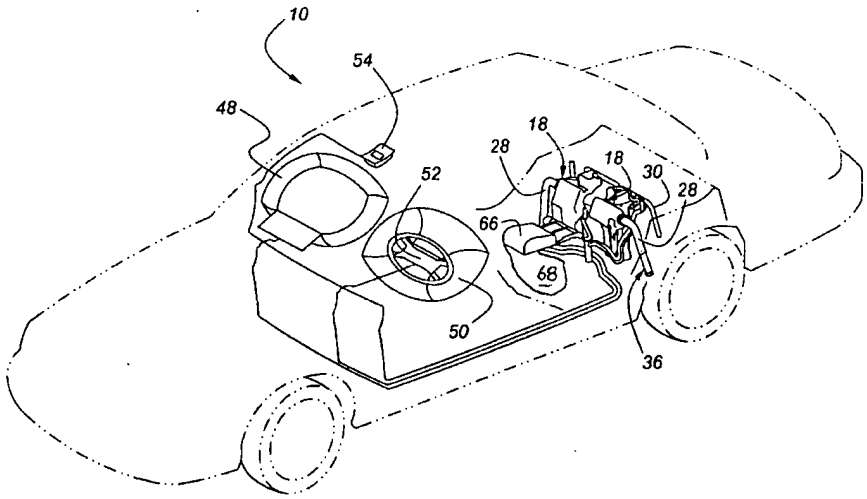
*Primary Examiner*—Kevin Shaver
*Assistant Examiner*—Darren Gorman
(74) *Attorney, Agent, or Firm*—Frank A. MacKenzie

(57) **ABSTRACT**

An automotive vehicle includes a vehicle body and at least one reservoir containing a fire suppressant agent. A distribution system receives the fire suppression agent from the reservoir and conducts the agent to at least one location about the vehicle's body in response to the determination by a sensor system and controller that the vehicle has been subjected to a significant impact. The sensor system and controller determine not only the magnitude of an impact upon the vehicle, but also track subsequent motion of the vehicle, as well as the time which has elapsed since an impact, so as to decide if and when the fire suppressant agent should be dispersed. Alternatively, the fire suppressant agent may be dispersed following activation of a manual switch.

**29 Claims, 6 Drawing Sheets**



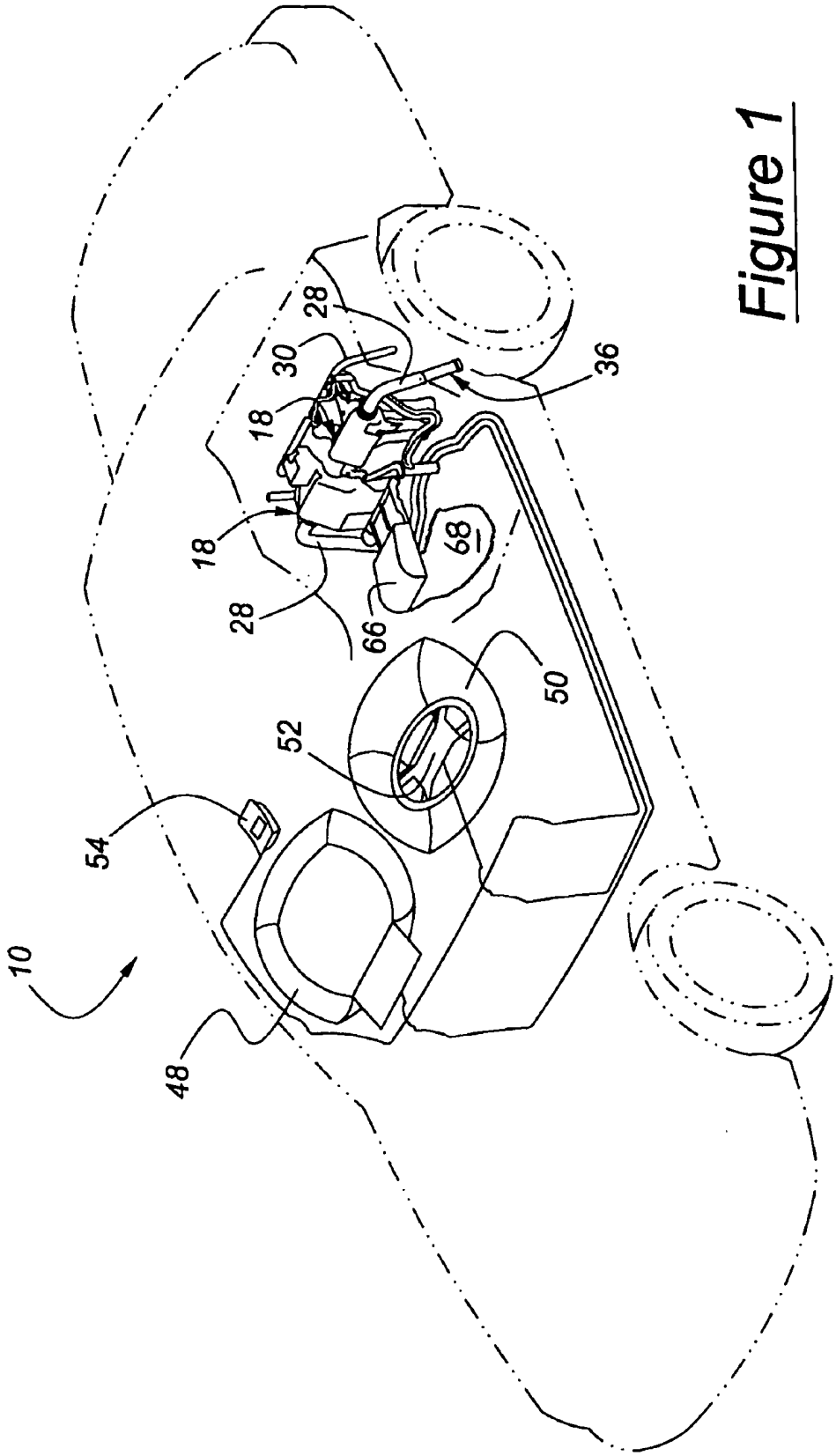



Figure 1

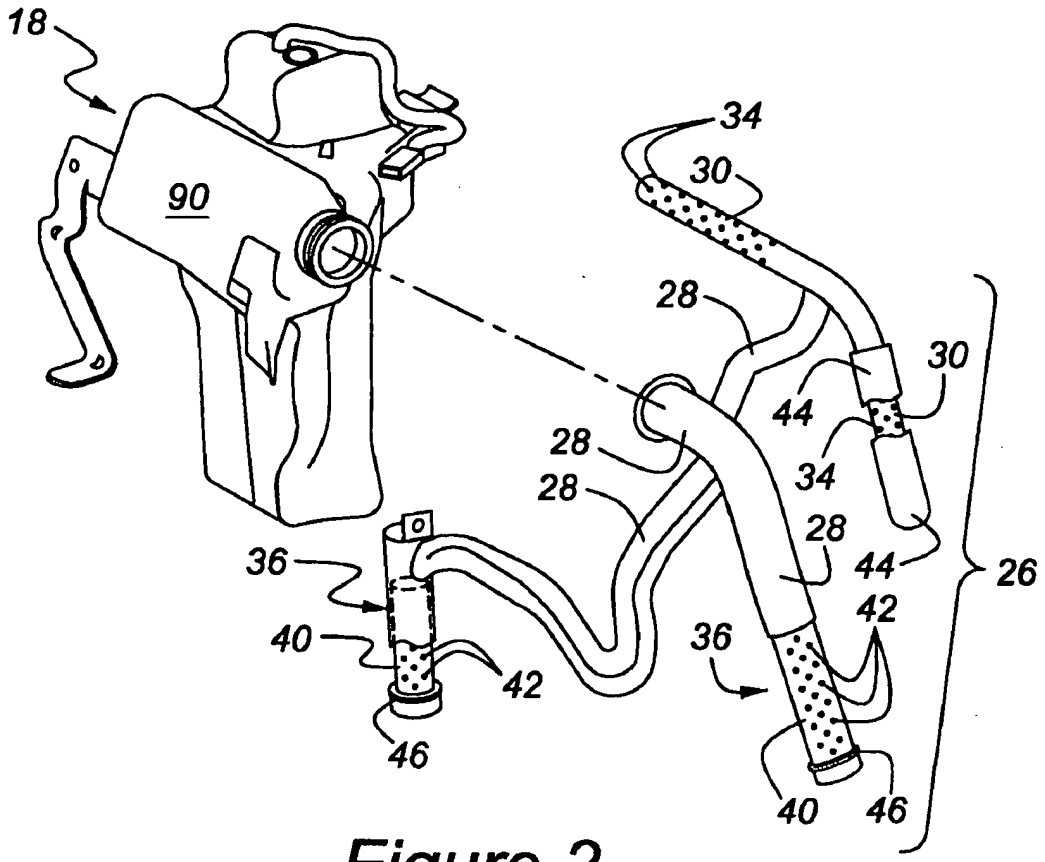



Figure 2

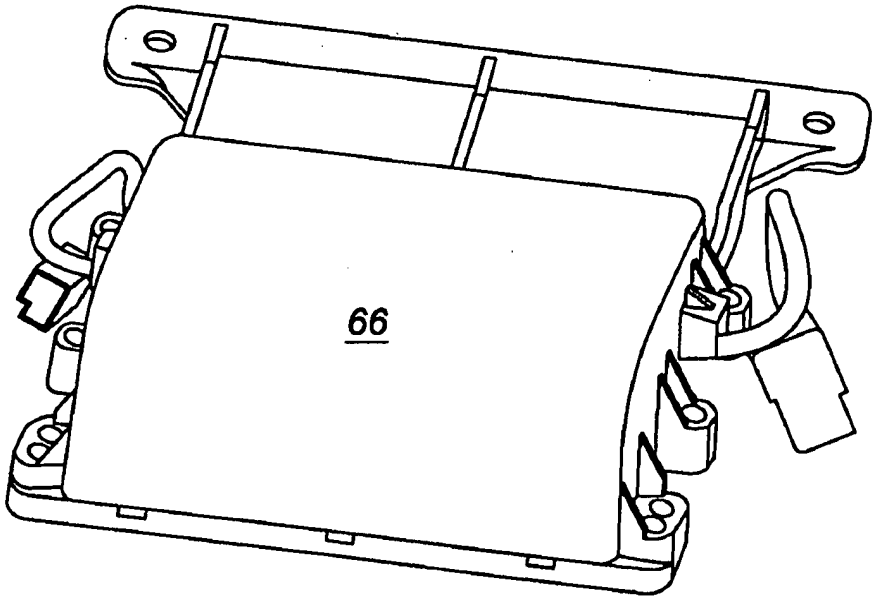



Figure 3

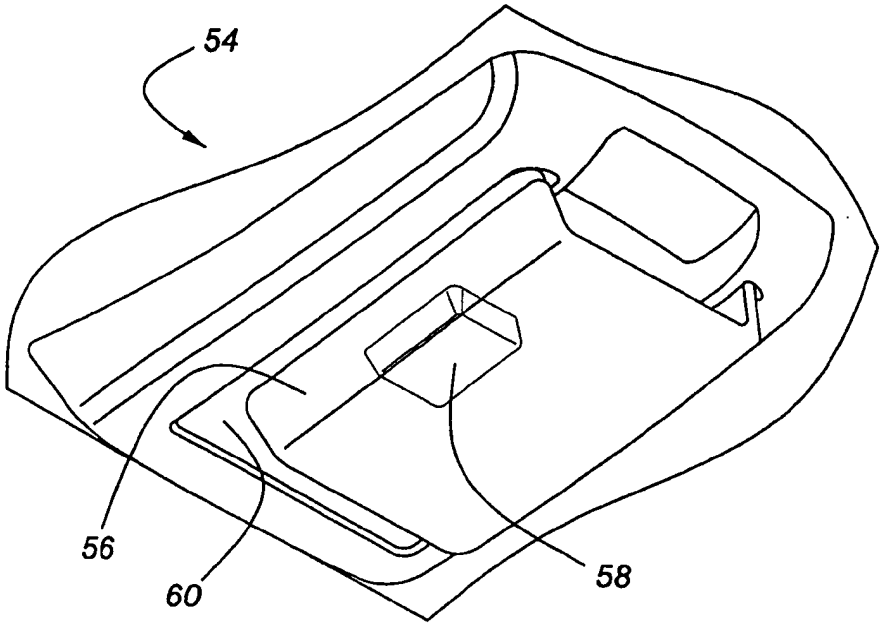



Figure 4

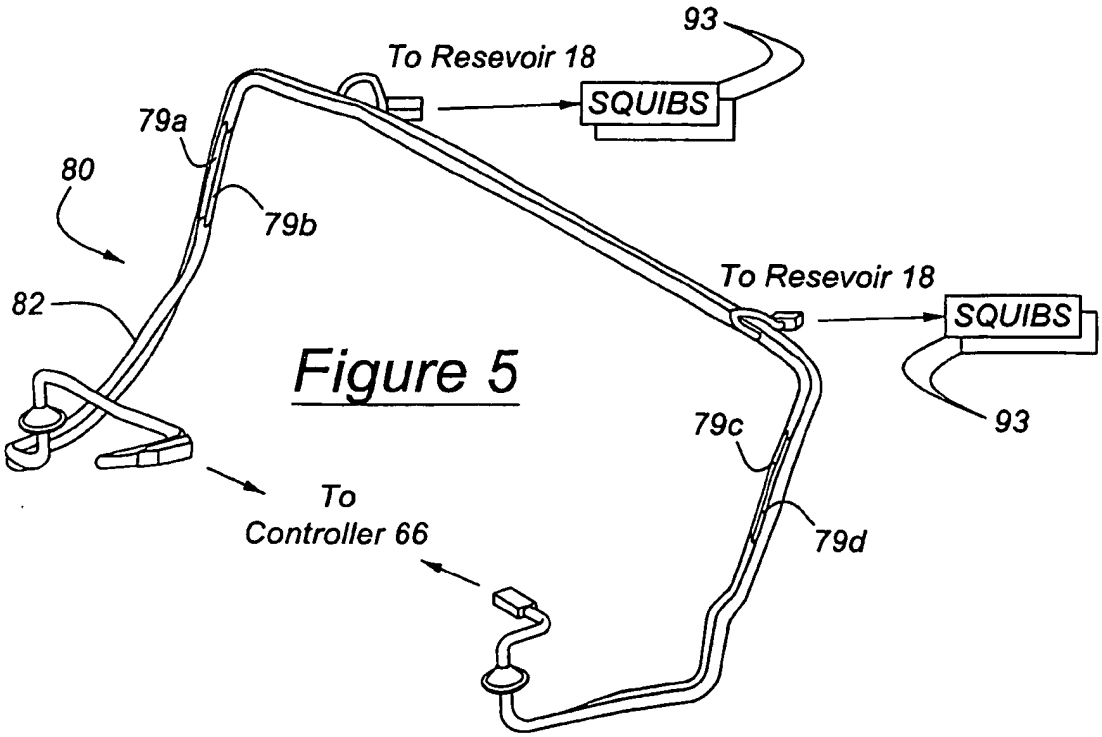
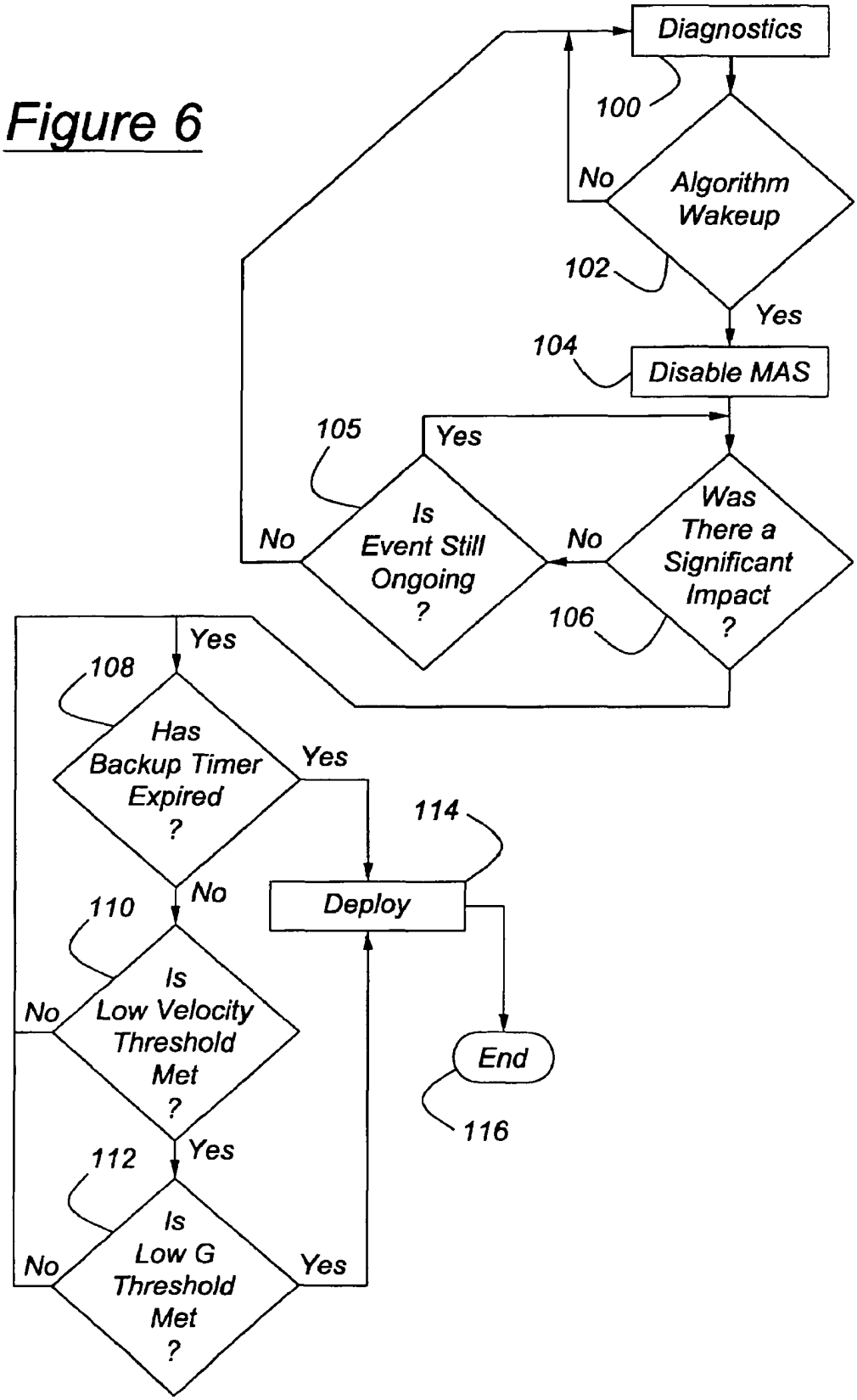



Figure 5

Figure 6


Diagnostics
100
Algorithm Wakeup
No
102
Yes
104
Disable MAS
105
Yes
Is Event Still Ongoing ?
No
Was There a Significant Impact ?
No
106
Yes
108
Has Backup Timer Expired ?
Yes
114
Deploy
No
110
Is Low Velocity Threshold Met ?
No
End
116
Yes
112
Is Low G Threshold Met ?
No
Yes

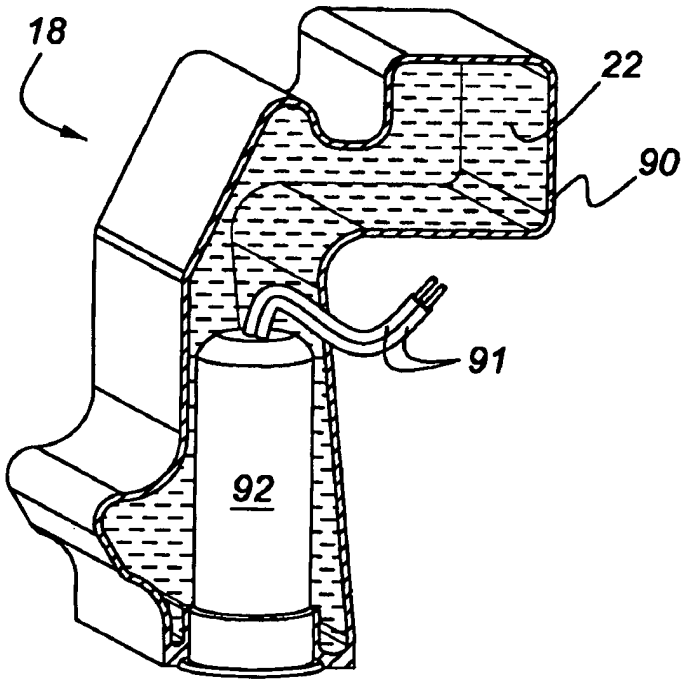



Figure 7

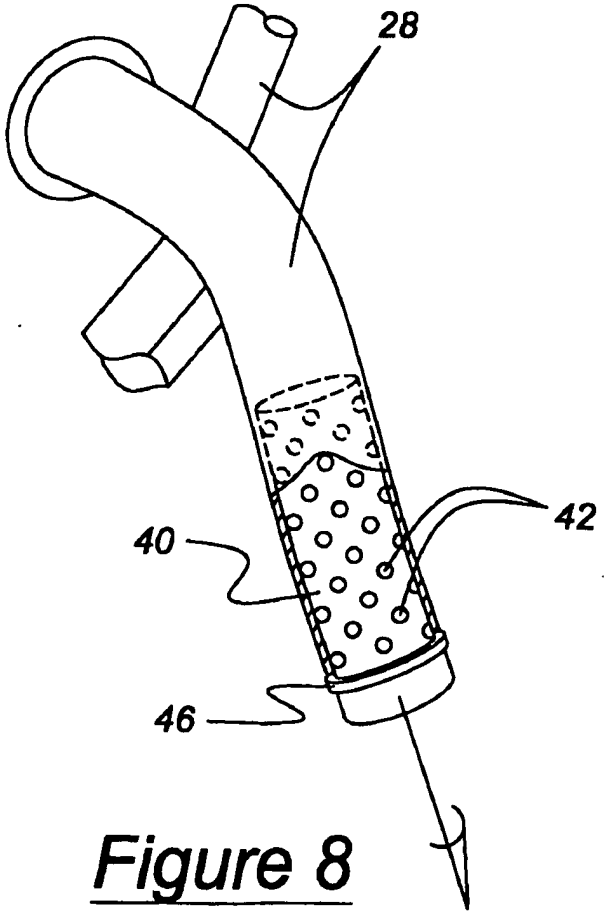



Figure 8

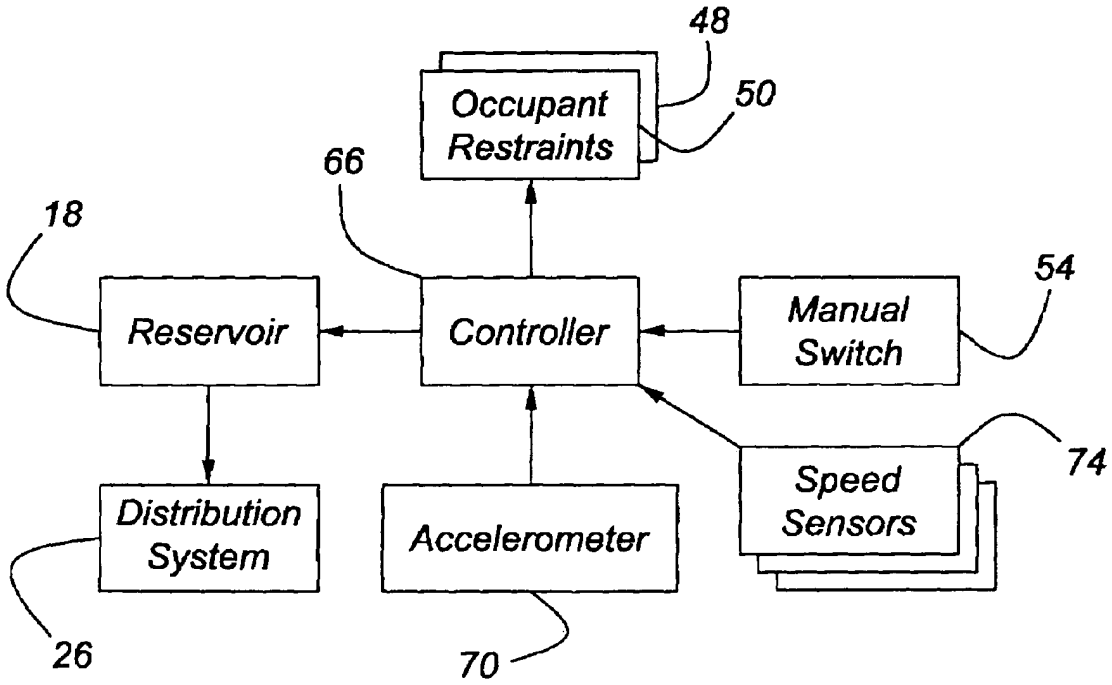

48
Occupant Restraints
50
66
18
Reservoir
Controller
Manual Switch
54
Speed Sensors
74
Distribution System
Accelerometer
26
70

Figure 9

# AUTOMOTIVE VEHICLE WITH FIRE SUPPRESSION SYSTEM

## FIELD OF THE INVENTION

The present invention relates to an automotive vehicle having an onboard apparatus for suppressing a vehicle fire.

## DISCLOSURE INFORMATION

Police vehicles are subject to increased exposure to collisions, particularly high-speed rear-end collisions, arising from the need for police officers to stop on the shoulders, or even in the traffic lanes, of busy highways. Unfortunately, other motorists are known to collide with police vehicles employed in this manner. These accidents can compromise the fuel system on any vehicle and may cause fires. The present system is designed to suppress the spread of, or potentially, to extinguish such a fire. U.S. Pat. No. 5,590,718, discloses an anti-fire system for vehicles in which a number of fixed nozzles are furnished with a fire extinguishing agent in response to an impact sensor. The system of the '718 patent suffers from a problem in that the release of the extinguishing agent is triggered immediately upon receipt of a significant impact. As a result, the anti-fire agent may be expended before the vehicle comes to a halt, with the further result being that a subsequent fire might not be treated by the system. Also, the '718 patent uses a valving system which could become clogged and therefore inoperable. U.S. Pat. No. 5,918,681 discloses a system which is similar to that disclosed in the '718 patent, inasmuch as the fire extinguishing system does not take into account movement of the vehicle following subjection of the vehicle to an impact. Finally, U.S. Pat. No. 5,762,145 discloses a fuel tank fire protection device including a powdered extinguishing agent panel attached to the fuel tank. In general, powder delivery systems are designed to prevent ignition of fires and are deployed upon impact. As a result, the powder may not be able to follow the post-impact movement of the struck vehicle and may not be able to prevent the delayed ignition or re-ignition of a fire.

The present fire suppression system provides significant advantages, as compared with prior art vehicular fire suppression systems.

## SUMMARY OF THE INVENTION

An automotive vehicle according to the present invention includes a vehicle body and at least one reservoir containing a fire suppressant agent. The reservoir containing a fire suppression agent is mounted in proximity to the body, preferably within the body or on an external surface of the body. A sensor system determines whether the vehicle has been subjected to an impact and also whether the vehicle is moving subsequent to such an impact. A distribution system receives the fire suppressant agent from the reservoir and conducts the fire suppressant agent to at least one location about the body, either internally or externally thereto. Finally, a controller operatively connected with the sensor system and the reservoir causes the reservoir to initiate delivery of the fire suppressant agent from the reservoir through the distribution system in the event that a significant impact having a suitable magnitude, duration, and other characteristics, is sensed.

According to another aspect of the present invention, the fire suppressant reservoir includes a tank for the suppressant agent and a propellant for establishing pressure within the tank sufficient to deliver suppressant agent from the tank to the distribution system. The propellant may take the form of either a pyrotechnic gas generator, or a canister containing compressed gas, or yet other types of propellants known to those skilled in the art and suggested by this disclosure.



According to another aspect of the present invention, the distribution system for the fire suppressant agent includes a number of conduits connected with the reservoir, with the conduits feeding a number of nozzles which may include both fixed and variable geometry nozzles. Release of the fire suppressant agent is governed by the controller, which is operatively connected with at least one accelerometer for sensing vehicle impact and at least one speed sensor for sensing vehicle speed.

In addition to the automatic deployment of the fire suppression system provided by the controller, a manually activatable switch is provided for causing the reservoir to initiate delivery of the fire suppressant agent from the reservoir to the distribution system. The manually activatable switch includes a manual pushbutton mounted upon a platform which is responsive not only to manual displacement of the pushbutton, but also to manual displacement of the platform itself.

According to another aspect of the present invention, a method for operating a fire suppression system installed in an automotive vehicle includes the steps of sensing an impact upon the vehicle, sensing the vehicle's speed following the impact, and discharging a fire suppression agent from an onboard reservoir in the event that the vehicle speed crosses a predetermined speed threshold following the sensing of an impact. As a variation of this method, a further step involves discharging the fire suppression agent only if the previous conditions are satisfied, as well as the additional condition that the vehicle is not experiencing acceleration in excess of a predetermined acceleration threshold.

The fire suppression agent will be discharged after a predetermined period of time following a significant, or triggering, impact upon the vehicle, regardless of subsequent vehicle speed or acceleration. In this manner, the fire suppression agent will be discharged in the event that the vehicle does not move following an impact. This also permits the system to discharge the suppression agent even if the system's sensors are damaged during an impact.

The sensor system used with the present fire suppression system may be combined with a control system for an occupant restraint airbag or other occupant restraints.

The present fire suppression system represents an advantage over other known systems because it has the capability to suppress a fire without the wheel "shadowing" which would otherwise occur if the flow of fire suppression agent were blocked by one or more wheels when the vehicle is stopped.

The present fire suppression system offers the additional advantage of not only automatic actuation, but also manual actuation, so as to allow the vehicle's operator to discharge the system even when the vehicle has not suffered a significant impact.

The present system offers the additional advantage that both variable and fixed geometry nozzles are used to assure adequate dispersion of the fire suppression agent, with the integrity of the system being protected from both road splash and objects thrown up by the vehicle's wheels during normal operation of the vehicle. Because the variable geometry nozzles are normally tucked up into the vehicle underbody region well above the road surface, these nozzles are pro-

tected from damage which would otherwise result from law enforcement maneuvers such as striking curbs and driving off-road.

The present system offers the additional advantage that the system operates without the need for an optical or other type of fire sensor which could become obscured, and therefore inoperable, in a vehicle underbody environment. The absence of such sensors allows the present system to begin its activation sequence immediately upon receipt of data indicating a triggering impact.

The present system offers the additional advantage that the system operates in the event of impacts which are directed against a vehicle not only longitudinally, but also laterally.

The present fire suppression system is designed advantageously to help reduce the risk of injury in high-speed rear impacts. The fire suppression system deploys chemicals designed to suppress the spread of fire or potentially extinguish a fire, thereby providing more time for occupants to escape from a crashed vehicle.

Other advantages, as well as objects and features of the present invention will become apparent to the reader of this specification.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a ghost perspective view of an automotive vehicle having a fire suppression system according to the present invention.

FIG. **2** is an exploded perspective view of a portion of a fire suppression system according to the present invention.

FIG. **3** is a perspective view of a control module used with a system according to the present invention.

FIG. **4** is a perspective view of a manually activatable switch used with a fire suppression system according to the present invention.

FIG. **5** illustrates a portion of a wiring harness used with the present system.

FIG. **6** is a flowchart showing a portion of the logic used to control a system according to the present invention.

FIG. **7** is a cutaway perspective view of a fire suppression agent reservoir according to one aspect of the present invention.

FIG. **8** is a perspective view of a variable geometry fire suppression agent nozzle according to one aspect of the present invention.

FIG. **9** is a block diagram of a fire suppression system and with additional components for occupant restraint according to one aspect of the present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in FIG. **1**, vehicle **10** has a passenger airbag restraint, **48**, and a driver's airbag restraint, **50**, mounted adjacent steering wheel **52**. A fire suppression system includes controller **66** which is mounted upon floor pan **68** of vehicle **10**, and reservoirs **18** which are mounted under floor pan **68** in the so-called kick-up area adjoining the rear axle of vehicle **10**. Those skilled in the art will appreciate in view of this disclosure that additional passenger restraint devices, such as seat belt pretensioners and side airbags, may be installed in a vehicle and controlled at least in part by, or in conjunction with, controller **66**.

FIG. **1** shows not only reservoirs **18** but also a portion of right and left side fire suppression conduits **28**, as well as fixed geometry nozzles **30** and variable geometry nozzles **36**. As seen in FIG. **1**, variable geometry nozzles **36** project downwardly to allow fire suppression agent to be expelled from reservoirs **18** and placed at a low angle to the ground surface the vehicle is operating upon. This mode of operation is possible because variable geometry nozzles **36** are, as shown in FIG. **2**, telescopingly extensible. This telescoping feature, which is shown in greater detail in FIG. **8**, is produced by a sliding spray head, **40**, which is slidingly engaged with conduit **28** such that gas pressure within conduit **28** forces spray head **40** downwardly into its extended position, causing fire suppression agent **22** to be discharged through a number of holes **42** formed in spray head **40**. As shown in FIG. **2**, at least two variable geometry nozzles **36** may be employed with single reservoir **18**, along with at least two fixed nozzles **30** which are spray bars each having a number of orifices **34**. While in their normally closed state, variable geometry nozzles **36** are liquid-tight by virtue of seals **46**, which are interposed between an end of each of spray heads **40** and the corresponding ends of conduits **28**. In a preferred embodiment, seals **46** comprise elastomeric boots attached to an outer surface of conduit **28**. Seals **46** are simply sheared by the deploying spray head **40** when the present system is discharged. Fixed nozzles **30** are also rendered liquid-tight by covers **44**, which are simply blown off when the present system is discharged. The sealing of nozzles **30** and **36** is important, because this prevents the ingress of road splash, which could block the system in sub-freezing weather or cause corrosion or blockage due to mud or other foreign matter.

Additional details of reservoir **18** are shown in FIG. **7**. Tank **90** contains approximately 1.5 L of fire suppression agent **22**, and a propellant **92**. Propellant **92** includes two squibs (not shown) which are activated simultaneously by controller **66** via lines **91** so as to release a large amount of gas, forcing fire suppressant agent **22** from tank **90** and into distribution system **26**, including conduit **28** and the various fixed and variable geometry nozzles. A preferred propellant, marketed by Primex Aerospace Company as model FS01-40, is a mixture including aminotetrazole, strontium nitrate, and magnesium carbonate. This is described in U.S. Pat. No. 6,702,033, which is hereby incorporated by reference into this specification.

Those skilled in the art will appreciate in view of this disclosure that other types of propellants could be used in the present system, such as compressed gas canisters and other types of pyrotechnic and chemical devices capable of creating a gas pressure force in a vanishingly small amount of time. Moreover, fire suppressant agent **22**, which preferably includes a water-based solution with hydrocarbon surfactants, fluorosurfactants, and organic and inorganic salts sold under the trade name LVS Wet Chemical Agent® by Ansul Incorporated, could comprise other types of agents such as powders or other liquids, or yet other agents known to those skilled in the art and suggested by this disclosure. If two reservoirs **18** are employed with a vehicle, as is shown in FIG. **1**, all four squibs will be deployed simultaneously.

FIG. **4** shows manually activatable switch **54** for use with the present system. As shown in FIG. **1**, switch **54** may be advantageously located on the headliner of vehicle **10** between the sun visors, or at any other convenient position. To use this switch **54**, hinged clear cover **56** is first opened by pressing on cover **56**. Thereafter, the fire suppression system may be triggered by manually pressing pushbutton **58**. If the vehicle occupants are not disposed to release cover **56**, the system may be triggered by merely sharply depressing cover **56**, thereby closing contacts (not shown) contained within platform **60**.

Because the present system is intended for use when the vehicle has received a severe impact, controller **66**, which is shown in FIG. **3**, contains a redundant power reserve or supply, which allows operation of the fire suppression system for about nine seconds, even if controller **66** becomes isolated from the vehicle's electrical power supply. Wiring harness **80**, as shown in FIG. **5**, is armored, and has a para-aramid fiber inner sheath, **82**, of about 2 mm in thickness, which helps to shield the conductors within harness **80** from abrasion and cutting during a vehicle impact event. This para-aramid fiber is sold under the trade name KEVLAR® by the DuPont company. This armoring helps to assure that communication between controller **66** and reservoirs **18** remains in effect during an impact event. Post-impact communications are further aided by redundancy in the control system. Specifically, four independent sets of primary conductors, **79***a–d*, extend from controller **66** to reservoirs **18** protected by sheath **82**. Moreover, an H-conductor, shown at **81** in FIG. **5**, extends between reservoirs **18**. Thus, if one or both of the primary conductors **79***a–b*, or **79***c–d*, extending to one of reservoirs **18** should become severed, H-conductor **81** will be available to carry the initiation signal from the undamaged lines to both of reservoirs **18**.

As noted above, an important feature of the present invention resides in the fact that the control parameters include not only vehicle impact, as measured by an accelerometer such as that shown at **70** in FIG. **9**, but also vehicle speed, as measured by means of speed sensors **74**, also shown in FIG. **9**. Speed sensors **74** may advantageously be existing sensors used with an anti-lock braking system or vehicle stability system. Alternatively, speed sensors **74** could comprise a global positioning sensor or a radar or optically based ground-sensing system. Accelerometer **70**, as noted above, could be used with a conventional occupant restraint airbag system, thereby maximizing use of existing systems within the vehicle. Advantageously, accelerometer **70** may be an amalgam of two or more accelerometers having differing sensing ranges. Such arrangements are known to those skilled in the art and suggested by this disclosure. At least a portion of the various sensors could either be integrated in controller **66** or distributed about vehicle **10**.

FIG. **6** shows a sequence which is used according to one aspect of the present invention for activating a release of fire suppressant agent.

Beginning at block **100**, controller **66** performs various diagnostics on the present system, which are similar to the diagnostics currently employed with supplemental restraint systems. For example, various sensor values and system resistances will be evaluated on a continuous basis. Controller **66** periodically moves to block **102**, wherein the control algorithm will be shifted from a standby mode to an awake mode in the event that a vehicle acceleration, or, in other words, an impact, having a magnitude in excess of a relatively low threshold is sensed by accelerometer **70**. Also, at block **102** a backup timer will be started. If the algorithm is awakened at block **102**, controller **66** disables manually activatable switch **54** at block **104** for a predetermined amount of time, say **150** milliseconds. This serves to prevent switch **54** from inadvertently causing an out-of-sequence release of fire suppression agent. Note that at block **104**, a decision has not yet been made to deploy fire suppression agent **22** as a result of a significant impact.

At block **106**, controller **66** uses output from accelerometer **70** to determine whether there has been an impact upon vehicle **10** having a severity is in excess of a predetermined threshold impact value. Such an impact may be termed a significant, or "trigger", impact. If an impact is less severe than a trigger impact, the answer at block **106** is "no", and controller **66** will move to block **105**, wherein an inquiry is made regarding the continuing nature of the impact event. If the event has ended, the routine moves to block **100** and continues with the diagnostics. If the event is proceeding, the answer at block **105** is "yes", and the routine loops to block **106**.

If a significant impact is sensed by the sensor system including accelerometer **70** and controller **66**, the answer at block **106** will be "yes." If such is the case, controller **66** moves to block **108** wherein the status of a backup timer is checked. This timer was started at block **102**.

Once the timer within controller **66** has counted up to a predetermined, calibratable time on the order of, for example, 5–6 seconds, controller **66** will cause propellant **92** to initiate delivery of fire suppressant agent **22**, provided the agent was not released earlier. Propellant **92** is activated by firing an electrical squib so as to initiate combustion of a pyrotechnic charge. Alternatively, a squib may be used to pierce, or otherwise breach, a pressure vessel. Those skilled in the art will appreciate in view of this disclosure that several additional means are available for generating the gas required to expel fire suppressant agent **22** from tank **90**. Such detail is beyond the scope of this invention. An important redundancy is supplied by having two squibs, **93**, (FIG. **5**), located within each of tanks **90**. All four squibs are energized simultaneously.

The velocity of the vehicle **10** is measured at block **110** using speed sensors **74**, and compared with a low velocity threshold. In essence, controller **66** processes the signals from the various wheel speed sensors **74** by entering the greatest absolute value of the several wheel speeds into a register. This register contains both a weighted count of the number of samples below a threshold and a count of the number of samples above the threshold. When the register value crosses a threshold value, the answer at block **110** becomes "yes". In general, the present inventors have determined that it is desirable to deploy fire suppression agent **22** prior to the vehicle coming to a stop. For example, fire suppression agent **22** could be dispersed when the vehicle slows below about 15 kph.

At block **112**, controller **66** enters a measured vehicle acceleration value into a second register. Thereafter, once the acceleration register value decays below a predetermined low g threshold, the answer becomes "yes" at block **112**, and the routine moves to block **114** and releases fire suppressant agent **22**. In essence, a sensor fusion method combines all available sensor information to verify that the vehicle is approaching a halt. The routine ends at block **116**. Because the present fire suppression system uses all of the available fire suppression agent **22** in a single deployment, the system cannot be redeployed without replacing at least reservoirs **18**.

FIG. **6** does not include the activation of occupant restraints **48** and **50**, it being understood that known control sequences, having much different timing constraints, may be employed for this purpose. In point of contrast, the low velocity threshold allows the present system to deliver the fire suppression agent while the vehicle is still moving, albeit at a very low velocity. This prevents the rear wheels of the vehicle from shadowing, or blocking dispersion of fire suppressant agent **22**. Also, in many cases, a vehicular fire may not become well-established until the vehicle comes to a halt.

Although the present invention has been described in connection with particular embodiments thereof, it is to be understood that various modifications, alterations, and adaptations may be made by those skilled in the art without departing from the spirit and scope of the invention set forth in the following claims.

What is claimed is:

1. An automotive vehicle, comprising:

a vehicle body;

a reservoir containing a fire suppressant agent, with said reservoir being mounted in proximity to said body;

a distribution system for receiving the fire suppressant agent from said reservoir and for conducting the fire suppressant agent to at least one location about said body; a sensor system for determining whether the vehicle has been subjected to an impact and whether the vehicle is moving subsequent to such an impact; and

a controller, operatively connected with said sensor system and said reservoir, for causing said reservoir to initiate delivery of the fire suppressant agent from the reservoir to the distribution system.

2. An automotive vehicle according to claim 1, wherein said reservoir comprises a tank containing a supply of suppression agent and a propellant for establishing a pressure within said tank sufficient to at least deliver the suppression agent from the tank to the distribution system.

3. An automotive vehicle according to claim 2, wherein said propellant comprises a pyrotechnic gas generator.

4. An automotive vehicle according to claim 2, wherein said propellant comprises a canister containing a compressed gas.

5. An automotive vehicle according to claim 1, wherein said distribution system comprises a plurality of conduits connected with said reservoir, with said conduits feeding a plurality of nozzles.

6. An automotive vehicle according to claim 5, wherein said plurality of nozzles comprises at least one pressure-responsive, variable geometry nozzle.

7. An automotive vehicle according to claim 5, wherein said plurality of nozzles comprises a plurality of pressure-responsive, variable geometry nozzles and a plurality of fixed geometry nozzles.

8. An automotive vehicle according to claim 1, wherein said sensor system comprises at least one accelerometer operatively connected with said controller.

9. An automotive vehicle according to claim 1, wherein said sensor system comprises at least one roadwheel speed sensor operatively connected with said controller.

10. An automotive vehicle according to claim 1, wherein said sensor system comprises a global positioning sensor operatively connected with said controller.

11. An automotive vehicle according to claim 1, further comprising a manually activatable switch for causing the reservoir to initiate delivery of the fire suppressant agent from the reservoir to the distribution system.

12. An automotive vehicle according to claim 11, wherein said manually activatable switch comprises a manual pushbutton mounted upon a platform, and a platform contact set responsive to manual displacement of said pushbutton as well as to manual displacement of a pivoting cover attached to the switch.

13. A method for operating a fire suppression system installed in an automotive vehicle, comprising the steps of:

sensing an impact upon the vehicle;

sensing the vehicle's speed following the impact; and

discharging a fire suppression agent from an onboard reservoir in the event that the vehicle's speed crosses a predetermined speed threshold following sensing of an impact.

14. A method for operating a vehicular fire suppression system according to claim 13, further comprising the step of discharging said fire suppression agent after a predetermined period of time following an impact upon the vehicle, in the event that the fire suppression agent was not previously discharged.

15. A method according to claim 13, wherein said predetermined speed threshold comprises a value greater than zero.

16. A method according to claim 13, wherein said fire suppression system incorporates a manually activatable switch which is rendered inoperative for a predetermined period of time following the sensing of an impact upon the vehicle.

17. An onboard fire suppression system for an automotive vehicle, comprising:

at least one reservoir containing a fire suppressant agent and a propellant for evacuating the fire suppressant agent from the reservoir, with said reservoir adapted for mounting to a vehicle;

a distribution system for receiving the fire suppressant agent from said reservoir, with said distribution system comprising at least one fixed geometry nozzle for discharging the fire suppressant agent in at least one location external to a vehicle;

a sensor system for determining not only whether a vehicle has been subjected to a trigger impact having a magnitude in excess of a predetermined impact threshold, but also whether the vehicle has been moving subsequent to such an impact;

a manually activatable switch, for use by an occupant of a vehicle, to indicate a desire to discharge fire suppressant agent from the reservoir;

a controller, operatively connected with said sensor system, said reservoir, and said manually activatable switch, for causing said propellant to initiate delivery of the fire suppressant agent from the reservoir to the distribution system in the event that: i) either the manually activatable switch has been activated, or ii) the sensor system has determined that a trigger impact has occurred and that either the vehicle's speed has crossed a predetermined threshold following the trigger impact, or that a predetermined period of time has passed following sensing of the trigger impact.

18. An onboard fire suppression system according to claim 17, wherein said sensor system and said controller comprise component parts of a system for controlling the deployment of an occupant restraint airbag.

19. An onboard fire suppression system according to claim 17, wherein said controller further comprises an integral power reserve for operating said controller and said sensor system and for causing the propellant to initiate delivery of the fire suppressant agent.

20. An onboard fire suppression system according to claim 17, wherein said fire suppressant agent comprises an aqueous based liquid.

21. An onboard fire suppression system according to claim 17, wherein said distribution system further comprises at least one variable geometry nozzle.

22. An onboard fire suppression system according to claim 21, wherein said at least one variable geometry nozzle and said at least one fixed geometry nozzle are liquid tight prior to initiation of delivery of the fire suppressant agent.

23. An onboard fire suppression system according to claim 17, comprising a plurality of reservoirs containing fire suppression agent.

24. An automotive vehicle, comprising:

a vehicle body;

a reservoir containing a fire suppressant agent, with said reservoir being mounted in proximity to said body;

a distribution system for receiving the fire suppressant agent from said reservoir and for conducting the fire suppressant agent to at least one location about said body; at least one occupant restraint airbag;

a sensor system for determining whether the vehicle has been subjected to a trigger impact having a severity in excess of a predetermined threshold impact value and whether the vehicle is moving subsequent to such an impact; and

a controller, operatively connected with said sensor system, said reservoir, and said occupant restraint airbag, for causing said airbag to deploy and for causing said reservoir to initiate delivery of the fire suppressant agent from the reservoir to the distribution system, in the event that said sensor system determines that a trigger impact has occurred.

25. An automotive vehicle according to claim 24, wherein, following a trigger impact, said controller initiates delivery of the fire suppressant agent in the event that either the vehicle's speed has crossed a predetermined threshold following the trigger impact, or that a predetermined period of time has passed following sensing of the trigger impact.

26. A method for operating a fire suppression system installed in an automotive vehicle, comprising the steps of:

sensing an impact upon the vehicle;

sensing the vehicle's speed following the impact; and

discharging a fire suppression agent from an onboard reservoir in the event that both the vehicle's speed crosses a predetermined speed threshold following sensing of an impact and the acceleration of the vehicle crosses a predetermined acceleration threshold.

27. A method for operating a vehicular fire suppression system according to claim 26, further comprising the step of discharging said fire suppression agent after a predetermined period of time following an impact upon the vehicle, in the event that the vehicle's speed has not crossed said predetermined speed threshold and the vehicle's acceleration has not crossed said predetermined acceleration threshold.

28. An automotive vehicle, comprising:

a vehicle body;

a reservoir comprising a tank containing both a fire suppressant agent and a pyrotechnic propellant, with said reservoir being mounted in proximity to said body;

a distribution system for receiving the fire suppressant agent from said reservoir and for conducting the fire suppressant agent to at least one location about said body; a sensor system for determining whether the vehicle has been subjected to an impact and whether the vehicle is moving subsequent to such an impact; and

a controller, operatively connected with said sensor system and said reservoir, for causing said propellant to initiate delivery of the fire suppressant agent from the reservoir to the distribution system.

29. An automotive vehicle according to claim 28, wherein said propellant is activated by a plurality of squibs connected by armored wiring to said controller.

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